Quality and Nutritive Value of Mott Dwarf Elephantgrass Silage with Biological Additives

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QUALITY AND NUTRITIVE VALUE OF MOTT DWARF ELEPHANTGRASS SILAGE WITH BIOLOGICAL ADDITIVES

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Abstract

This experiment was conducted to study the effects of cellulase enzymes and lactic acid bacteria on the fermentation characteristics, chemical composition and nutritive value of *Pennisetum purpureum* cv Mott silage. Five kinds of preparation were tested: sugar molasses (control); sugar molasses and cellulase enzymes; cellulase enzymes; concentrate of lactic acid bacteria and sugar molasses and concentrate of lactic acid bacteria. Significant differences ($P<0.05$) were found in fermentation quality and chemical composition of control silage as compared to the biological additives treated silage. Addition of cellulase enzymes and lactic acid bacteria resulted in decrease of pH value, cell wall content and increased lactic acid concentration. The biological additives increased silage intake and daily live weight by growing steers.

Keywords: *Pennisetum purpureum* cv Mott, silage, nutritive value.

Introduction

Cattle production based on the maximun utilization of pastures and forages requires necessarily an adequate grassland management policy. During the last two decades different aspects in respect to grassland management have been studied in tropical conditions. One of these practices is the use of biological and chemical additives for improving fermentation characteristics and silage quality (Sajko, 1997).

Dwarf elephantgrass (*Pennisetum purpureum* cv Mott) is a tropical perennial bunchgrass usually managed by grazing or cut and carry. In tropical dry conditions to insure the availability of the grass throughout the year, the grass is conserved as silage. The grass contains a high moisture which affect the fermentation process. An increasing number of studies (Gordon, 1989; Yokota *et al.*, 1998) have been reported on benefit of biological conservation agents on silage quality.

The objectives of this silage study were to determinate if dwarf elephantgrass could be adequately preserved as silage using biological additives and the conversion of dwarf elephantgrass silage into animal products.

Material and Methods

The experiment was conducted in 1998 at a farm located in western region of Venezuela with climate and vegetation corresponding to a tropical dry forest, with an average annual temperature of 29 ºC and rainfall between 1200 and 1400 mm with bimodal distribution. Soil is flat topography with a slight slope, the texture varies from sandy to claying loam and present a sub-superficial claying horizon at a depth varying from 0 to 50 cm with a pH of 5.5 to 6.5 (COPLANARH, 1974).

Fully established stands of dwarf elephantgrass cv Mott was clipped to a 15 cm stubble. Nitrogen (150 kg/ha) was applied inmediately after harvesting. Plants were harvested mechanically at 6 weeks (the dry matter content was 19.4 %), regrowth and ensiled without wilting in concrete bunkers closed at one end with permanent ramp and at the other end with movable boards, covered with black polythene film.

Additives were used at the time of ensiling by spraying them on the forage into the silo.

The following kinds of additives were used:

Sugar molasses (Control), at 5% with a dry matter content of 79.2%.

Sugar molasses and cellulase enzymes (SMF), at 1:1 rate.

Cellulase enzymes (F), at rate of 0.01% fresh forage.

Concentrate of lactic acid bacteria (B), application rate $1x10^{10}$ g fresh sample.

Sugar molasses and concentrate of lactic acid bacteria (SMB), at 1:2 ratio.

Silos were opened after a 90-day storage period. Silage samples were analyzed for pH, dry matter content (DM), chemical composition (carried out according to Van Soest and Wine, 1967), crude protein using a technicon auto analyzer and organic acids were determined by gas chromatography (Supelco, 1985).

The silages were evaluated using for each of the treatments 12 growing Brahman steers, their average body weight was 312 kg. The experiment covered 14 weeks of which 2 weeks were used for observation. During this period the steers were adjusted to the experimental feeds and observed as their general suitable for the experiment.

Dietary forages consisted of 50% of fresh dwarf elephantgrass and 50% silages. The silages were individually fed and fresh forages was group fed.

All animals had free access to mineral salt and water.

The animals were individually weighed at 14-d intervals after overnight fast. Daily liveweight gains and silage intake were estimated.

A randomized block design was applied. ANOVA and Duncan's test (α=0.05) were performed (SAS, 1989).

Results and Discussion

The chemical and fermentation characteristics of the silage are shown in Table 1. The quality of the silages were generally good. All silages treated with biological additives were well preserved as indicated by their low pH values, high lactic acid concentrations and low butiric acid levels.

Mean pH values recorded for all silages ranged from 4.91-4.09. Highest pH values were consistently obtained for the control, which showed the lowest lactic and acetic acids levels.

No marked differences were found in crude protein among the silages.

The use of preparation with cellulase enzymes caused an increased degradation of plant cell wall constituents that were more susceptible to bacterial decomposition. These results are consistent with those of Ridla and Vehida (1998) and Sajko *et al.*, (1997) who reported that cellulase enzymes addition was capable to breakdown the component of structural carbohydrates during ensiling.

Lactic and acetic acids are major components of fermentation responsible for the increase in acidity of ensiled biomass (Woolford, 1984). In the present study, silages treated with lactic acid bacteries resulted in highest amount of organic acids and lower final pH value improved the qualitative parameters of the silage compared with the control.

The control treatment showed the highest moisture content, moderate final pH and levels of butyric acid of 25.9 g/kg DM that would suggest some clostridial activity.

Addition of both biological additives increased dry matter content of silage and accelerated initial lactic acid fermentation by increasing substrate for lactic acid producing microbes.

Table 2 gives mean silage intake and liveweight gains by growing steers. Summarized results of feeding trial indicate that biological additives improved silage intake. There was a slight increase in silage intake and daily live weight gains (DLW) from the biological additive treated silage as compared to the control silage.

These experimented data suggest that silage intake and DLW were hampered by diet factors like high moisture, and butyric acid content and, low fiber digestibility.

Ruiz *et al.*, (1994) observed reduction in intake with each increase in NDF concentration and estimated decline in DMI of about 0.02 kg/100 kg of BW for each 1% moisture in diet.

The results from this research indicate the possibility of altering the fermentation of silage of dwarf elephantgrass with biological additives so as to improve it's utilization by growing steers.

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Table 1 - Chemical composition and fermentation characteristics of silages.

Chemical	Silage type				
Composition	Control	SMF	F	B	SMB
pH	4.91[a]	4.27[a]	4.39[a]	4.11[a]	4.09[a]
DM (g/kg)	185[b]	211[a]	208[a]	218[a]	217[a]
Crude Protein (%DM)	10.1[a]	10.8[a]	10.6[a]	10.8[a]	10.8[a]
NDF (%DM)	65.3[b]	55.1[a]	57.8[a]	61.8[ab]	60.1[ab]
ADF (%DM)	40.2[b]	33.6[a]	36.5[ab]	37.4[ab]	36.3[ab]
Hemicellulose (%DM)	28.1[b]	21.4[a]	22.5[a]	24.3[a]	25.2[ab]
Acid Content (g/kg DM)					
Lactic	45.6[d]	145.1[ab]	126.7[c]	166.7[a]	187.2[a]
Acetic	72.8[c]	81.2[b]	79.5[c]	96.5[a]	101.4[a]
Propionic	41.6[a]	17.2[b]	19.1[c]	14.1[bc]	12.5[c]
Butyric	25.9	-	-	-	-

Values on the same row with different superscripts are different, Duncan Test (P<0.05).

Table 2 - Silage intake and daily liveweight gains (DLG) by growing steers

	Silages types				
	Control	SMF	F	B	SMB
Silage intake (kg DM/d/steer)	2.45^{b}	3.12^{a}	3.15^{a}	3.16^{a}	3.20^{a}
DLG (kg/d/steer)	0.65b	0.69^{ab}	0.71^{a}	0.73^{a}	0.75^{a}

Values on the same line with different superscript are different, Duncan Test (P<0.05)